

U.S. Patent Application Serial No. 09/743,531
Amendment filed July 6, 2006
Reply to OA dated February 6, 2006

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Canceled).

1 Claim 2 (Previously Presented): A micro-bubble generating system, comprising
2 a container main unit having an interior space of frusto-conical shape and being closed at one
3 end,
4 a pressurized liquid inlet opening communicating tangentially with said interior space,
5 a gas introducing hole opening at one end of said frusto-conical space to generate a swirling gas
6 that is exposed to contact with swirling pressurized liquid introduced through said liquid inlet, and
7 a swirling gas-liquid mixture outlet opening at the other end of said interior space and operative
8 to discharge micro-bubbles therefrom, said interior space having a largest bore diameter substantially
9 equal to a bore diameter of said gas-liquid mixture outlet opening.

1 Claim 3 (Previously Presented): A micro-bubble generating system according to one of claims
2 2 or 10, wherein a plurality of pressurized liquid inlet openings are tangentially disposed on a part of a

3 circumferential surface of the container and communicate at spaced locations about the circumference
4 of the container wall with the interior space.

1 Claim 4 (Currently Amended): A micro-bubble generating system according to one of claims
2 2 or 10, wherein said pressurized liquid inlet opening opens on a part of the circumferential surface of
3 the container near said ~~gas-mixture outlet~~ gas-liquid mixture outlet opening from said interior space.

Claim 5 (Canceled).

1 Claim 6 (Withdrawn): A micro-bubble generating system according to one of claims 1 or 2,
2 wherein a baffle plate is arranged closely spaced from the swirling gas-liquid mixture outlet from the
3 interior space.

1 Claim 7 (Withdrawn): A micro-bubble generating system according to one of claims 1 or 2,
2 wherein a partition plate for closing the outlet is attached, leaving only a partial opening defining the
3 swirling gas-liquid mixture outlet from the interior space.

1 Claim 8 (Previously Presented): A method for micro-bubble generation, using a micro-bubble
2 generating system, which comprises a container main unit having an interior space with a bottom, a
3 pressurized liquid inlet opened in a tangential direction on a part of a circumferential surface of an inner

4 wall of the space, a gas introducing hole opened at the bottom of the interior
5 space, and a swirling gas-liquid mixture outlet opened at a mixture discharge end of the interior space,
6 whereby said method comprising the steps of:

7 forming a swirling gas cavity along which self-sucked gas is swirled and guided while flowing
8 in a narrow stream of swirling gas flow in the interior space; and

9 generating micro-bubbles by forcibly cutting off and smashing the swirling gas cavity by contact
10 with swirling pressurized liquid due to a difference of swirling velocity between the gas and liquid
11 portions in the swirling gas cavity, said interior space having a largest bore diameter substantially equal
12 to a bore diameter of said gas-liquid mixture outlet.

1 Claim 9 (Currently Amended): A method for micro-bubble generation, using a micro-bubble
2 generating system, which comprises a container main unit having an interior space with a bottom, a
3 pressurized liquid inlet opened in a tangential direction on a part of a circumferential surface of an inner
4 wall of the space, a gas introducing hole opened at the bottom of the interior space, and a swirling gas-
5 liquid mixture outlet opened at a mixture discharge end of the interior space, whereby said method
6 comprising the steps of:

7 forming a swirling gas cavity for swirling and guiding self-sucked gas along a narrow gas flow
8 stream in the interior space;

9 generating micro-bubbles by forcibly cutting off and smashing the swirling gas cavity by contact
10 with swirling pressurized liquid due to a difference of swirling velocity between [[the]] portions in the

11 swirling gas cavity; and

12 continuously cutting off and smashing the swirling gas cavity in said interior space due to a
13 relative increase of the difference in rotating velocity between a rotating cut-off portion and smashing
14 portion in the step of generating micro-bubbles, the liquid passing through the rotating cut-off portion
15 of gas cavity being rapidly diffused while ~~[[the]]~~ a diffused rotating ~~gas fluid~~ gas-liquid mixture is stably
16 formed and an angle of diffusion of the rotating mixture is large, and wherein a difference of rotating
17 velocity between gas and liquid streams is relatively increased between the rotating cut-off portion and
18 the smashing portion, said interior space having a largest bore diameter substantially equal to a bore
19 diameter of said gas-liquid mixture outlet.

1 Claim 10 (Currently Amended): A micro-bubble generating system, comprising:
2 a container having an interior space defined by a surface of revolution,
3 a container bottom closing said space at one axial end thereof and a gas-liquid mixture outlet
4 opening at the other end thereof, said interior space having a largest bore diameter substantially equal
5 to a bore diameter of said gas-liquid mixture outlet opening,
6 a liquid inlet opening communicating tangentially with said interior space adjacent said gas-
7 liquid mixture outlet opening,
8 means for injecting pressurized liquid through said liquid inlet opening as a centrifugally flowing
9 ~~fluid~~ liquid into said interior space,
10 a gas introducing hole disposed in the container bottom and operative to introduce gas into said

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11 interior space, said stream of gas being induced to swirl as a narrow low pressure flow stream in said
12 interior space by said centrifugally flowing liquid,
13 wherein said swirling pressurized liquid introduced through said pressurized liquid inlet contacts
14 said narrow swirling gas flow stream adjacent said gas-liquid mixture outlet to tear down said swirling
15 gas flow stream and thereby generate micro-bubbles for discharge from said gas-liquid mixture outlet
16 opening.

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